

**Research Proposal  
for the use of  
Neutron Science Facilities**

**Proposal Number:**  
20111541  
**Submission Number:**  
S1533  
**Date Received:**  
03/09/11

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<b>Program Advisory Subcommittee:</b> Defense-related Nuclear Science			
<b>Focus Area:</b>			
<b>Flight Path/Instrument:</b> 4FP90L / FIRE House		<b>Dates Desired:</b>	
<b>Estimated Beam Time (days):</b> 45		<b>Impossible Dates:</b>	
<b>Days Recommended:</b> 0			
<b>TITLE</b> Fission Time Projection Chamber development: Measurement of the U-238 to U-235 fission cross section ratio		<input type="checkbox"/> Continuation of Proposal #:  <input type="checkbox"/> Ph.D Thesis for:	
<b>Principal Investigator:</b> Tovesson, Fredrik <b>Institution:</b> Los Alamos National Laboratory <b>Citizenship:</b> Sweden <b>Phone:</b> 665-9652 <b>FAX:</b> <b>Email:</b> tovesson@lanl.gov <b>Local Contact:</b> Tovesson, Fredrik			
<b>Co-Proposers</b>	<b>Institution</b>	<b>Citizenship</b>	<b>E-mail Address</b>
Burgett, Eric A Donald, Isenhower Duke, Dana Greife, Uwe Heffner, Mike Hill, Tony S Klay, Jennifer	Georgia Institute of Technology Abilene Christian University California Polytechnic State Uni Colorado School of Mines Lawrence Livermore National Lab Other California Polytechnic State Uni	United States of Am United States of Am United States of Am Germany United States of Am United States of Am United States of Am	eric.burgett@ors.gatech.edu isenhowe@acu.edu dllduke@calpoly.edu ugreife@mines.edu mheffner@llnl.gov tony.hill@inl.gov jklay@calpoly.edu
<b>RESEARCH AREA</b>		<b>FUNDING AGENCY</b>	
<input type="checkbox"/> Biological and Life Science <input type="checkbox"/> Chemistry <input type="checkbox"/> National Security <input type="checkbox"/> Earth Sciences <input type="checkbox"/> Engineering <input type="checkbox"/> Environmental Sciences <input checked="" type="checkbox"/> Nuc. Physics/chemistry <input type="checkbox"/> Astrophysics <input type="checkbox"/> Few Body Physics <input type="checkbox"/> Fund. Physics <input type="checkbox"/> Elec. Device Testing <input type="checkbox"/> Dosimetry/Med/Bio <input type="checkbox"/> Earth/Space Sciences <input type="checkbox"/> Materials Properties/Test <input type="checkbox"/> Other:		<input type="checkbox"/> Mat'l Science (incl Cond Matter) <input type="checkbox"/> Medical Applications <input type="checkbox"/> Nuclear Physics <input type="checkbox"/> Polymers <input type="checkbox"/> Physics (Excl Condensed Matter) <input checked="" type="checkbox"/> Instrument Development <input checked="" type="checkbox"/> Neutron Physics <input checked="" type="checkbox"/> Fission <input checked="" type="checkbox"/> Reactions <input type="checkbox"/> Spectroscopy <input type="checkbox"/> Nuc. Accel. Reactor Eng. <input checked="" type="checkbox"/> Def. Science/Weapons Physics <input type="checkbox"/> Radiography <input type="checkbox"/> Threat Reduction/Homeland Sec. <input type="checkbox"/> Other:	
		<input type="checkbox"/> DOE/BES <input type="checkbox"/> DOE/OBER <input checked="" type="checkbox"/> DOE/NNSA <input checked="" type="checkbox"/> DOE/NE <input type="checkbox"/> DOE/SC <input type="checkbox"/> DOE/Other  <input type="checkbox"/> DOD <input type="checkbox"/> NSF <input type="checkbox"/> Industry <input type="checkbox"/> NASA <input type="checkbox"/> NIH <input type="checkbox"/> Foreign:  <input type="checkbox"/> Other US Gov't: <input type="checkbox"/> Other:	

**PUBLICATIONS****Publications:**

NONE

**Abstract:** S1533\_TPCproposal1.pdf

By electronic submission, the Principal Investigator certifies that this information is correct to the best of their knowledge.

**Safety and Feasibility Review***(to be completed by LANSCE Instrument Scientist/Responsible)*

- ☐ No further safety review required      ☐ To be reviewed by Experiment Safety Committee  
☐ Approved by Experiment Safety Committee, Date:

**Recommended # of days:****Change PAC Subcommittee and/or  
Focus Area to:****Change Instrument to:****Comments for PAC to consider:****Instrument scientist signature:****Date:**



## **Fission Time Projection Chamber development**

### **- Measurement of the U-238 to U-235 fission cross section ratio**

The Pu-239 fission cross section needs to be known with very high accuracy for certain nuclear applications, and specifically to about 1% in the neutron energy range from 100 keV to 20 MeV for defense applications. Conventional methods for measuring fission cross sections are limited to 3-5%, and are thus insufficient for meeting the target accuracy. A Time Projection Chamber (TPC) for high precision fission cross sections is currently being developed in collaboration between four national laboratories and six universities to address this nuclear data need.

A prototype of the fission TPC was first tested in a neutron beam during the 2010 LANSCE run cycle, and was shown to meet all performance requirements. A picture of the detector installed on the 4FP90L flight path is shown in Fig. 1. The detector was operated both with a blank target and with a U-238 sample, and particle tracks were observed both from light charged-particles and fission fragments. We are now requesting beam time on the 4FP90L flight path to perform a measurement of the U-238/U-235 fission cross section ratio to demonstrate the ability to accurately measure fission cross sections with this new instrument.

The sample for this measurement consists of a stainless steel backing with actinide deposits on both sides, U-235 on one side and U-238 on the other. The sample will be placed in on the central cathode plane of the TPC, and detector then placed in beam on 4PF90L. The number of neutron-induced fission events will be counted by registering the heavy-ion tracks created in the gas volume of the detector, and the time-of-flight will be used to determine the incident neutron energy. The cross section ratio between U-238 and U-235 is then calculated using the known mass of the actinide materials. Since this cross section ratio is well known, the measurement will help benchmark the TPC performance.

**Beam time request:** 6 weeks of beam time is requested to complete the measurement. The beam time requested is guided by the statistical accuracy required and the systematical studies needed to generate an accurate cross section.

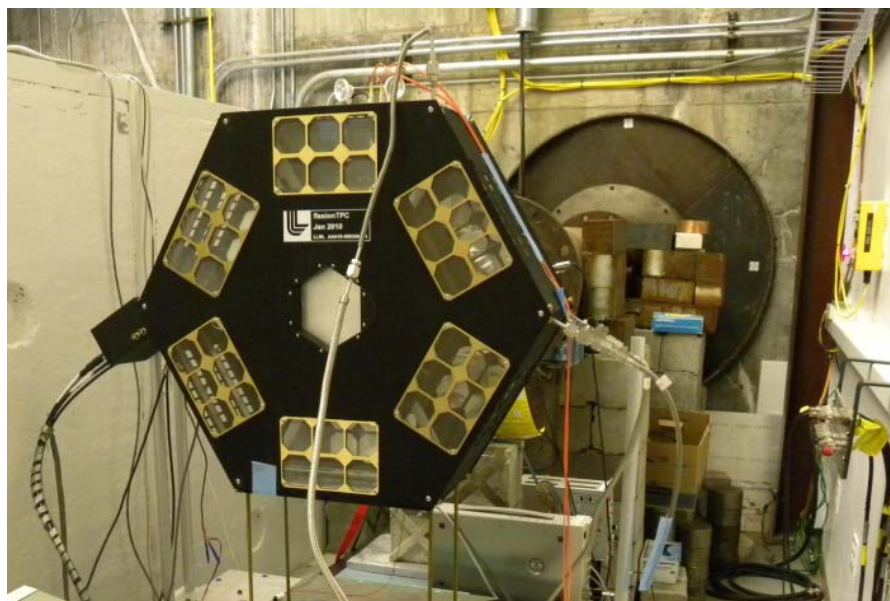


Fig. 1: The prototype fission TPC installed on 4FP90L during the 2010 LANSCE run cycle.

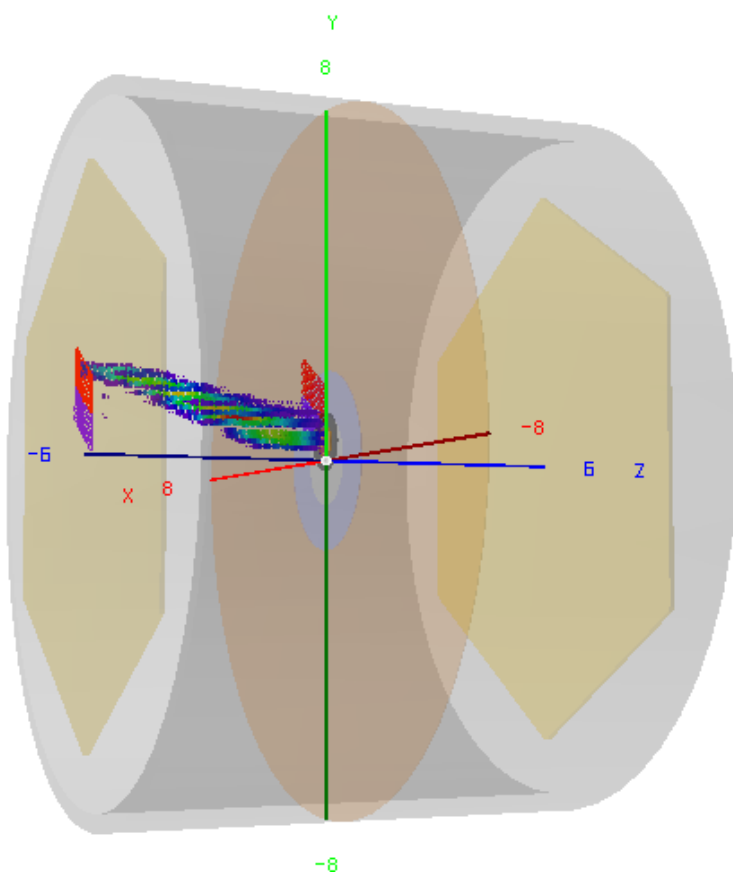


Fig. 2: Visualization of a neutron-induced fission fragment track collected with the fission TPC.